

**AMENDMENT NO. 2 AUGUST 2023**  
**TO**  
**IS 1161 : 2014 STEEL TUBES FOR STRUCTURAL PURPOSES-SPECIFICATION**  
*( Fifth Revision )*

*(Page 1, clause 1)* — Substitute the following for the existing:

‘This standard covers the requirements for hot finished welded(HFW), hot finished seamless (HFS), and electric resistance welded (ERW) or high frequency induction welded (HFIW) steel tubes for structural purposes’

*(Page 1, clause 3)* — Substitute the following for the existing:

‘Steel tubes covered by this standard shall be designated by their nominal bore and wall thickness (see Table 1). They shall be further graded as YSt 210, YSt 240, YSt 310, YSt 355, YSt 420 and YSt 460 depending on the yield strength of the material (see Table 2). The designation of the steel tubes shall, therefore, include the nominal bore of the tube and grade of the material.’

*(Page 1, clause 5)* — Substitute the following for the existing:

## **5 MANUFACTURE AND MATERIAL**

**5.1** Steel tubes shall be manufactured through one of the following processes:

- a) Hot Finished Welded(HFW);
- b) Hot finished seamless (HFS);
- c) Cold finished seamless (CDS); and
- d) Electric resistance welded or high frequency induction welded (ERW or HFIW).

NOTE — Tubes made by manual welding are not covered by this standard.

**5.2** Material for manufacture of seamless tubes shall be of steel made by any process at discretion of the manufacturer which shall show not more than 0.040 percent of sulphur and 0.040 percent of phosphorus. For manufacture of welded tubes, hot rolled steel strips conforming to IS 10748/IS 2062 shall be used.

**5.3** The applicable grades of steel tubes for the manufacturing processes mentioned at **5.1** shall be as given in Table 3.’

*(Page 1, clause 6.1.3)* — Substitute the following for the existing:

‘Tubes of thickness higher than the specified minimum thickness of tubes for all diameters (NB and their corresponding OD), as shown in Table 1 may be supplied, if so mutually agreed to between the purchaser and the manufacturer.’

[*Page 4, Table 2, Sl No. iv*] — Add the following after Sl No. iv) to the existing table:

**Table 2 Tensile Properties of Steel Tubes for Structural Purposes**  
*(Clause 3.1 and 11.2)*

Sl No.	Grade	Tensile Strength Min, MPa	Yield Strength Min, MPa	Elongation on Gauge Length $5.65\sqrt{S_0}$ Min, %
(1)	(2)	(3)	(4)	(5)
v)	YSt 420	500	420	10
vi)	YSt 460	530	460	10

[Page 4, Table 3 (See also Amendment No.1)] — Substitute the following for the existing:

**Table 3 Applicable Grades of Steel Tubes for Manufacturing Processes**  
(Clause 5.3)

<b>Sl No.</b> (1)	<b>Manufacturing Process</b> (2)	<b>Applicable Grade</b> (3)
i)	HFW	YSt 210 YSt 240
ii)	HFS/CDS	YSt 210 YSt 240 YSt 310 YSt 355 YSt 420 YSt 460
iii)	ERW/HFIW	YSt 210 YSt 240 YSt 310 YSt 355 YSt 420 YSt 460
as welded, heat treated or cold drawn and normalized		

NOTE — If required the copper bearing steel may be used to impart weather resistant properties in the steel. Copper content shall be between 0.20 percent to 0.35 percent subject to mutual agreement between the supplier and the purchaser.

[Page 4, Table 4, Sl No. iv)] — Add the following after Sl No. iv) to the existing table:

**Table 4 Flattening Requirement in Metal**  
(Clause 11.3.2)

<b>Sl No.</b> (1)	<b>Manufacturing Process Metal</b> (2)	<b>Steel Grade</b> (3)	<b>Weld (Distance Between the Plates)</b> (4)	<b>Parent (Distance Between the Plates)</b> (5)
v)	HFS/CDS/ERW/HFIW	YSt 420	85 percent of OD	75 percent of OD
vi)	HFS/CDS/ERW/HFIW	YSt 460	85 percent of OD	75 percent of OD

(Page 2 and 3, Table 1) — Substitute the following for the existing table:

**Table 1 Sizes and Properties of Steel Tubes for Structural Purposes**  
(Clauses 3.1, 6.1, 6.1.1, 6.1.2 and 6.1.3)

NB mm (1)	OD mm (2)	Thickness mm (3)	Mass kg/m <sup>3</sup> (4)	Area of Cross Section cm <sup>2</sup> (5)	Internal Volume cm <sup>3</sup> /m (6)	Surface		Moment of Inertia cm <sup>4</sup> /m (9)	Modulus of Section cm <sup>3</sup> (10)	Radius of Gyration cm (11)	Square of Radius of Gyration cm <sup>2</sup> (12)
						External cm <sup>3</sup> /m (7)	Internal cm <sup>3</sup> /m (8)				
15	21.3	2	0.95	1.21	235	669	543	0.571	0.536	0.686	0.47
15	21.3	2.5	1.16	1.48	209	669	512	0.664	0.623	0.671	0.45
15	21.3	3	1.35	1.72	184	669	481	0.741	0.696	0.656	0.43
20	26.9	2	1.23	1.56	412	845	719	1.22	0.907	0.883	0.78
20	26.9	2.5	1.50	1.92	377	845	688	1.44	1.07	0.87	0.75
20	26.9	3	1.77	2.25	343	845	657	1.63	1.21	0.85	0.73
25	33.7	2	1.56	1.99	693	1 059	933	2.51	1.49	1.12	1.26
25	33.7	2.5	1.92	2.45	647	1 059	902	3.00	1.78	1.11	1.22
25	33.7	3	2.27	2.89	603	1 059	870	3.44	2.04	1.09	1.19
32	42.4	2	1.99	2.54	1 158	1 332	1 206	5.19	2.45	1.43	2.05
32	42.4	2.5	2.46	3.13	1 099	1 332	1 175	6.26	2.95	1.41	2.00
32	42.4	3	2.91	3.71	1 041	1 332	1 144	7.25	3.42	1.40	1.95
32	42.4	4	3.79	4.83	929	1 332	1 081	8.99	4.24	1.36	1.86
40	48.3	2	2.28	2.91	1 541	1 517	1 392	7.81	3.23	1.64	2.68
40	48.3	2.5	2.82	3.60	1 473	1 517	1 360	9.46	3.92	1.62	2.63
40	48.3	3	3.35	4.27	1 405	1 517	1 329	11.00	4.55	1.61	2.58
40	48.3	4	4.37	5.57	1 276	1 517	1 266	13.77	5.70	1.57	2.47
40	48.3	5	5.34	6.80	1 152	1 517	1 203	16.15	6.69	1.54	2.37
50	60.3	2	2.88	3.66	2 489	1 894	1 769	15.58	5.17	2.06	4.25
50	60.3	2.5	3.56	4.54	2 402	1 894	1 737	18.99	6.30	2.05	4.18
50	60.3	3	4.24	5.40	2 316	1 894	1 706	22.22	7.37	2.03	4.12
50	60.3	4	5.55	7.07	2 148	1 894	1 643	28.17	9.34	2.00	3.98
50	60.3	5	6.82	8.69	1 987	1 894	1 580	33.48	11.10	1.96	3.85
65	76.1	2	3.65	4.66	4 083	2 391	2 265	31.98	8.40	2.62	6.87
65	76.1	2.5	4.54	5.78	3 970	2 391	2 234	39.19	10.30	2.60	6.78
65	76.1	3	5.41	6.89	3 859	2 391	2 202	46.10	12.11	2.59	6.69
65	76.1	4	7.11	9.06	3 642	2 391	2 139	59.06	15.52	2.55	6.52

Table 1 (Continued)

NB	OD	Thickness	Mass	Area of Cross Section	Internal Volume	Surface		Moment of Inertia	Modulus of Section	Radius of Gyration	Square of Radius of Gyration
						External	Internal				
mm	mm	mm	kg/m <sup>3</sup>	cm <sup>2</sup>	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>4</sup> /m	cm <sup>3</sup>	cm	cm <sup>2</sup>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
65	76.1	5	8.77	11.17	3 432	2 391	2 077	70.92	18.64	2.52	6.35
65	76.1	6	10.37	13.21	3 227	2 391	2 014	81.76	21.49	2.49	6.19
65	76.1	6.3	10.84	13.81	3 167	2 391	1 995	84.82	22.29	2.48	6.14
80	88.9	2	4.29	5.46	5 661	2 793	2 667	51.57	11.60	3.07	9.44
80	88.9	2.5	5.33	6.79	5 529	2 793	2 636	63.37	14.26	3.06	9.34
80	88.9	3	6.36	8.10	5 398	2 793	2 604	74.76	16.82	3.04	9.23
80	88.9	4	8.38	10.67	5 140	2 793	2 542	96.34	21.67	3.00	9.03
80	88.9	5	10.35	13.18	4 889	2 793	2 479	116	26.18	2.97	8.83
80	88.9	6	12.27	15.63	4 645	2 793	2 416	135	30.36	2.94	8.64
80	88.9	6.3	12.83	16.35	4 572	2 793	2 397	140	31.55	2.93	8.58
90	101.6	2	4.91	6.26	7 482	3 192	3 066	77.6	15.28	3.52	12.41
90	101.6	2.5	6.11	7.78	7 329	3 192	3 035	95.6	18.82	3.50	12.28
90	101.6	3	7.29	9.29	7 178	3 192	3 003	113	22.25	3.49	12.16
90	101.6	4	9.63	12.26	6 881	3 192	2 941	146	28.80	3.45	11.93
90	101.6	5	11.91	15.17	6 590	3 192	2 878	177	34.93	3.42	11.70
90	101.6	6	14.15	18.02	6 305	3 192	2 815	207	40.68	3.39	11.47
90	101.6	6.3	14.81	18.86	6 221	3 192	2 796	215	42.34	3.38	11.40
100	114.3	2.5	6.89	8.78	9 383	3 591	3 434	137	24.02	3.95	15.63
100	114.3	3	8.23	10.49	9 212	3 591	3 402	163	28.44	3.94	15.50
100	114.3	4	10.88	13.86	8 875	3 591	3 340	211	36.93	3.90	15.23
100	114.3	5	13.48	17.17	8 544	3 591	3 277	257	44.96	3.87	14.96
100	114.3	6	16.03	20.41	8 219	3 591	3 214	300	52.53	3.83	14.71
100	114.3	6.3	16.78	21.38	8 123	3 591	3 195	313	54.72	3.82	14.63
100	114.3	8	20.97	26.72	7 589	3 591	3 088	379	66.40	3.77	14.20
110	127	2.9	8.88	11.31	11 537	3 990	3 707	217.78	34.30	4.39	19.26
110	127	3.2	9.77	12.45	11 423	3 990	3 789	238.60	37.57	4.38	19.17
110	127	3.6	10.96	13.96	11 272	3 990	3 764	265.87	41.87	4.36	19.05
110	127	4	12.13	15.46	11 122	3 990	3 738	292.61	46.08	4.35	18.93
110	127	5	15.04	19.16	10 751	3 990	3 676	357.14	56.24	4.32	18.64
110	127	6	17.90	22.81	10 387	3 990	3 613	418.44	65.90	4.28	18.35
110	127	6.3	18.75	23.89	10 279	3 990	3 594	436.22	68.70	4.27	18.26

Table 1 (Continued)

NB	OD	Thickness	Mass	Area of Cross Section	Internal Volume	Surface		Moment of Inertia	Modulus of Section	Radius of Gyration	Square of Radius of Gyration
						External	Internal				
mm	mm	mm	kg/m <sup>3</sup>	cm <sup>2</sup>	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>4</sup> /m	cm <sup>3</sup>	cm	cm <sup>2</sup>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
125	139.7	3	10.11	12.88	14 040	4 389	4 200	301	43.11	4.83	23.37
125	139.7	4	13.39	17.05	13 623	4 389	4 137	393	56.24	4.80	23.04
125	139.7	5	16.61	21.16	13 212	4 389	4 075	481	68.80	4.77	22.71
125	139.7	6	19.78	25.20	12 808	4 389	4 012	564	80.78	4.73	22.39
125	139.7	6.3	20.73	26.40	12 688	4 389	3 993	589	84.27	4.72	22.29
125	139.7	8	25.98	33.10	12 018	4 389	3 886	720	103	4.66	21.76
125	139.7	10	31.99	40.75	11 253	4 389	3 760	862	123	4.60	21.15
135	152.4	3	11.05	14.08	16 833	4 788	4 599	393	51.58	5.28	27.91
135	152.4	4	14.64	18.65	16 377	4 788	4 536	514	67.42	5.25	27.55
135	152.4	5	18.18	23.15	15 926	4 788	4 474	630	82.62	5.21	27.19
135	152.4	6	21.66	27.60	15 482	4 788	4 411	740.57	97.19	5.18	26.84
135	152.4	6.3	22.70	28.92	15 350	4 788	4 392	772.96	101.44	5.17	26.73
135	152.4	8	28.49	36.29	14 612	4 788	4 285	948.82	124.52	5.11	26.14
135	152.4	10	35.12	44.74	13 768	4 788	4 159	1 139.53	149.54	5.05	25.47
150	165.1	3	11.99	15.28	19 881	5 187	4 998	502	60.81	5.73	32.86
150	165.1	4	15.89	20.24	19 384	5 187	4 935	657	79.61	5.70	32.46
150	165.1	5	19.74	25.15	18 894	5 187	4 873	807	97.70	5.66	32.07
150	165.1	6	23.54	29.99	18 409	5 187	4 810	950	115	5.63	31.69
150	165.1	6.3	24.67	31.43	18 265	5 187	4 791	992	120	5.62	31.57
150	165.1	8	30.99	39.48	17 460	5 187	4 684	1 221	148	5.56	30.93
150	168.3	3	12.23	15.58	20 688	5 287	5 099	532	63.25	5.85	34.17
150	168.3	4	16.21	20.65	20 182	5 287	5 036	697	82.84	5.81	33.76
150	168.3	5	20.14	25.65	19 681	5 287	4 973	856	102	5.78	33.36
150	168.3	6	24.02	30.59	19 187	5 287	4 910	1 009	120	5.74	32.97
150	168.3	6.3	25.17	32.06	19 040	5 287	4 891	1 053	125	5.73	32.85
150	168.3	8	31.63	40.29	18 218	5 287	4 785	1 297	154	5.67	32.20
150	168.3	10	39.04	49.73	17 273	5 287	4 659	1 564	186	5.61	31.45
170	177.8	4	17.14	21.84	22 645	5 586	5 334	825	93	6.15	37.78
170	177.8	5	21.31	27.14	22 114	5 586	5 272	1 014	114	6.11	37.36
170	177.8	6	25.42	32.38	21 590	5 586	5 209	1 196	135	6.08	36.94
170	177.8	6.3	26.65	33.94	21 434	5 586	5 190	1 250	141	6.07	36.81

Table 1 (Continued)

NB	OD	Thickness	Mass	Area of Cross Section	Internal Volume	Surface		Moment of Inertia	Modulus of Section	Radius of Gyration	Square of Radius of Gyration
						External	Internal				
mm	mm	mm	kg/m <sup>3</sup>	cm <sup>2</sup>	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>4</sup> /m	cm <sup>3</sup>	cm	cm <sup>2</sup>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
170	177.8	8	33.50	42.68	20 561	5 586	5 083	1 541	173	6.01	36.12
170	177.8	10	41.38	52.72	19 557	5 586	4 957	1 862	209	5.94	35.32
170	177.8	12	49.07	62.51	18 578	5 586	4 832	2 159	243	5.88	34.54
170	177.8	12.5	50.96	64.91	18 337	5 586	4 800	2 230	251	5.86	34.35
175	193.7	4	18.71	23.84	27 084	6 085	5 834	1 073	111	6.71	45.00
175	193.7	5	23.27	29.64	26 504	6 085	5 771	1 320	136	6.67	44.54
175	193.7	6	27.77	35.38	25 930	6 085	5 708	1 560	161	6.64	44.08
175	193.7	6.3	29.12	37.09	25 759	6 085	5 689	1 630	168	6.63	43.95
175	193.7	8	36.64	46.67	24 801	6 085	5 583	2 016	208	6.57	43.19
175	193.7	10	45.30	57.71	23 697	6 085	5 457	2 442	252	6.50	42.31
175	193.7	12	53.77	68.50	22 618	6 085	5 331	2 839	293	6.44	41.45
175	193.7	12.5	55.86	71.16	22 352	6 085	5 300	2 934	303	6.42	41.24
200	219.1	4	21.22	27.03	35 000	6 883	6 632	1 564	143	7.61	57.86
200	219.1	5	26.40	33.63	34 340	6 883	6 569	1 928	176	7.57	57.33
200	219.1	6	31.53	40.17	33 686	6 883	6 506	2 282	208	7.54	56.81
200	219.1	6.3	33.06	42.12	33 491	6 883	6 487	2 386	218	7.53	56.65
200	219.1	8	41.65	53.06	32 397	6 883	6 381	2 960	270	7.47	55.78
200	219.1	10	51.57	65.69	31 134	6 883	6 255	3 598	328	7.40	54.78
200	219.1	12	61.29	78.07	29 895	6 883	6 129	4 200	383	7.33	53.79
200	219.1	12.5	63.69	81.13	29 590	6 883	6 098	4 345	397	7.32	53.55
225	244.5	5	29.53	37.62	43 189	7 681	7 367	2 699	221	8.47	71.73
225	244.5	6	35.29	44.96	42 456	7 681	7 304	3 199	262	8.43	71.15
225	244.5	6.3	37.01	47.14	42 237	7 681	7 285	3 346	274	8.42	70.97
225	244.5	8	46.66	59.44	41 007	7 681	7 179	4 160	340	8.37	70.00
225	244.5	10	57.83	73.67	39 584	7 681	7 053	5 073	415	8.30	68.86
225	244.5	12	68.81	87.65	38 186	7 681	6 927	5 938	486	8.23	67.75
225	244.5	12.5	71.52	91.11	37 841	7 681	6 896	6 147	503	8.21	67.48
250	273	5	33.05	42.10	54 325	8 577	8 262	3 781	277	9.48	89.81
250	273	6	39.51	50.33	53 502	8 577	8 200	4 487	329	9.44	89.16
250	273	6.3	41.44	52.79	53 256	8 577	8 181	4 696	344	9.43	88.96
250	273	8	52.28	66.60	51 875	8 577	8 074	5 852	429	9.37	87.86
250	273	10	64.86	82.62	50 273	8 577	7 948	7 154	524	9.31	86.59
250	273	12	77.24	98.39	48 695	8 577	7 823	8 396	615	9.24	85.33

Table 1 (Continued)

NB (1)	OD (2)	Thickness (3)	Mass (4)	Area of Cross Section (5)	Internal Volume (6)	Surface		Moment of Inertia (9)	Modulus of Section (10)	Radius of Gyration (11)	Square of Radius of Gyration (12)
						External (7)	Internal 1 (8)				
mm	mm	mm	kg/m <sup>3</sup>	cm <sup>2</sup>	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>3</sup> /m	cm <sup>4</sup> /m	cm <sup>3</sup>	cm	cm <sup>2</sup>
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
300	323.9	6	47.04	59.92	76 405	10 176	9 799	7 572	468	11.24	126.37
300	323.9	6.3	49.34	62.86	76 111	10 176	9 780	7 929	490	11.23	126.14
300	323.9	8	62.32	79.39	74 458	10 176	9 673	9 910	612	11.17	124.82
300	323.9	10	77.41	98.61	72 536	10 176	9 547	12 158	751	11.10	123.29
300	323.9	12	92.30	117.58	70 639	10 176	9 422	14 320	884	11.04	121.78
300	323.9	12.5	95.99	122.29	70 168	10 176	9 390	14 847	917	11.02	121.41
350	355.6	5	43.23	55.07	93 807	11 172	10 857	8 464	476	12.40	153.68
350	355.6	6	51.73	65.90	92 725	11 172	10 795	10 071	566	12.36	152.82
350	355.6	6.3	54.27	69.13	92 401	11 172	10 776	10 547	593	12.35	152.56
350	355.6	8	68.58	87.36	90 579	11 172	10 669	13 201	742	12.29	151.11
350	355.6	10	85.23	108.57	88 457	11 172	10 543	16 223	912	12.22	149.42
350	355.6	12	101.68	129.53	86 361	11 172	10 418	19 139	1 076	12.16	147.76
350	355.6	12.5	105.77	134.74	85 841	11 172	10 386	19 852	1 117	12.14	147.34
350	355.6	16	134.00	170.70	82 245	11 172	10 166	24 663	1 387	12.02	144.48
350	355.6	20	165.53	210.86	78 228	11 172	9 915	29 792	1 676	11.89	141.28
400	406.4	6	59.25	75.47	122 170	12 767	12 390	15 128	745	14.16	200.45
400	406.4	6.3	62.16	79.19	121 798	12 767	12 372	15 849	780	14.15	200.15
400	406.4	8	78.60	100.13	119 704	12 767	12 265	19 874	978	14.09	198.48
400	406.4	10	97.76	124.53	117 264	12 767	12 139	24 476	1 205	14.02	196.54
400	406.4	12	116.72	148.69	114 849	12 767	12 013	28 937	1 424	13.95	194.62
400	406.4	12.5	121.43	154.68	114 249	12 767	11 982	30 031	1 478	13.93	194.14
400	406.4	16	154.05	196.24	110 093	12 767	11 762	37 449	1 843	13.81	190.84
400	406.4	20	190.58	242.78	105 439	12 767	11 511	45 432	2 236	13.68	187.13
400	406.4	25	235.15	299.55	99 762	12 767	11 197	54 702	2 692	13.51	182.61
450	457	6	66.73	85.01	155 528	14 357	13 980	21 618	946	15.95	254.30
450	457	6.3	70.02	89.20	155 109	14 357	13 961	22 654	991	15.94	253.96
450	457	8	88.58	112.85	152 745	14 357	13 854	28 446	1 245	15.88	252.08
450	457	10	110.24	140.43	149 987	14 357	13 729	35 091	1 536	15.81	249.89
450	457	12	131.69	167.76	147 254	14 357	13 603	41 556	1 819	15.74	247.71
450	457	12.5	137.03	174.55	146 574	14 357	13 572	43 145	1 888	15.72	247.17
450	457	16	174.01	221.67	141 863	14 357	13 352	53 959	2 361	15.60	243.42
450	457	20	215.54	274.58	136 572	14 357	13 100	65 681	2 874	15.47	239.21
450	457	25	266.34	339.29	130 100	14 357	12 786	79 415	3 475	15.30	234.06

Table 1 (Continued)

NB mm (1)	OD mm (2)	Thickness mm (3)	Mass kg/m <sup>3</sup> (4)	Area of Cross Section cm <sup>2</sup> (5)	Internal Volume cm <sup>3</sup> /m (6)	Surface		Moment of Inertia cm <sup>4</sup> /m (9)	Modulus of Section cm <sup>3</sup> (10)	Radius of Gyration cm (11)	Square of Radius of Gyration cm <sup>2</sup> (12)
						External cm <sup>3</sup> /m (7)	Internal cm <sup>3</sup> /m (8)				
450	457	30	315.91	402.44	123 786	14 357	12 472	92 173	4 034	15.13	229.04
500	508	6	74.28	94.62	193 221	15 959	15 582	29 812	1 174	17.75	315.05
500	508	6.3	77.95	99.30	192 753	15 959	15 563	31 246	1 230	17.74	314.68
500	508	8	98.65	125.66	190 117	15 959	15 457	39 280	1 546	17.68	312.58
500	508	10	122.81	156.45	187 038	15 959	15 331	48 520	1 910	17.61	310.13
500	508	12	146.79	186.99	183 984	15 959	15 205	57 536	2 265	17.54	307.70
500	508	12.5	152.75	194.58	183 225	15 959	15 174	59 755	2 353	17.52	307.10
500	508	16	194.14	247.31	177 952	15 959	14 954	74 909	2 949	17.40	302.90
500	508	20	240.70	306.62	172 021	15 959	14 703	91 428	3 600	17.27	298.18
500	508	25	297.79	379.35	164 748	15 959	14 388	110 918	4 367	17.10	292.39
500	508	30	353.65	450.50	157 633	15 959	14 074	129 173	5 086	16.93	286.73
550	559	6	81.83	104.24	234 998	17 562	17 185	39 850.86	1 425.79	19.55	382.31
550	559	8	108.71	138.48	231 574	17 562	17 059	52 564.94	1 880.68	19.48	379.58
550	559	10	135.39	172.47	228 175	17 562	16 933	65 001.14	2 325.62	19.41	376.88
550	559	12	161.88	206.21	224 801	17 562	16 808	77 163.53	2 760.77	19.34	374.19
550	559	14	188.17	239.70	221 452	17 562	16 682	89 056.15	3 186.27	19.28	371.53
550	559	16	214.26	272.94	218 128	17 562	16 556	100 683.03	3 602.26	19.21	368.88
550	559	18	240.15	305.93	214 829	17 562	16 431	112 048.15	4 008.88	19.14	366.26
550	559	20	265.85	338.66	211 556	17 562	16 305	123 155.47	4 406.28	19.07	363.65
600	610	6	89.37	113.85	280 862	19 164	18 787	51 924	1 702	21.36	456.07
600	610	6.3	93.80	119.48	280 298	19 164	18 768	54 439	1 785	21.35	455.62
600	610	8	118.77	151.30	277 117	19 164	18 661	68 551	2 248	21.29	453.09
600	610	10	147.97	188.50	273 397	19 164	18 535	84 847	2 782	21.22	450.13
600	610	12	176.97	225.44	269 703	19 164	18 410	100 814	3 305	21.15	447.19
600	610	12.5	184.19	234.64	268 783	19 164	18 378	104 755	3 435	21.13	446.45
600	610	16	234.38	298.58	262 389	19 164	18 158	131 781	4 321	21.01	441.37
600	610	20	291.01	370.71	255 176	19 164	17 907	161 490	5 295	20.87	435.63
600	610	25	360.67	459.46	246 301	19 164	17 593	196 906	6 456	20.70	428.56
600	610	30	429.11	546.64	237 583	19 164	17 279	230 476	7 557	20.53	421.63
700	711	6	104.32	132.89	383 746	22 337	21 960	82 568	2 323	24.93	621.33
700	711	6.3	109.49	139.47	383 088	22 337	21 941	86 586	2 436	24.92	620.80
700	711	8	138.70	176.68	379 367	22 337	21 834	109 162	3 071	24.86	617.84

Table 1 (Continued)

NB mm (1)	OD mm (2)	Thickness mm (3)	Mass kg/m <sup>3</sup> (4)	Area of Cross Section cm <sup>2</sup> (5)	Internal Volume cm <sup>3</sup> /m (6)	Surface		Moment of Inertia cm <sup>4</sup> /m (9)	Modulus of Section cm <sup>3</sup> (10)	Radius of Gyration cm (11)	Square of Radius of Gyration cm <sup>2</sup> (12)				
						External cm <sup>3</sup> /m (7)									
						1	1								
700	711	10	172.88	220.23	375 013	22 337	21 708	135 301	3 806	24.79	614.38				
700	711	12	206.86	263.52	370 684	22 337	21 583	160 991	4 529	24.72	610.93				
700	711	12.5	215.33	274.30	369 605	22 337	21 551	167 343	4 707	24.70	610.07				
700	711	16	274.24	349.35	362 101	22 337	21 331	211 040	5 936	24.58	604.10				
700	711	20	340.82	434.17	353 618	22 337	21 080	259 351	7 295	24.44	597.35				
700	711	25	422.94	538.78	343 157	22 337	20 766	317 357	8 927	24.27	589.03				
700	711	30	503.83	641.83	332 853	22 337	20 452	372 790	10 486	24.10	580.83				
750	762	6	111.86	142.50	441 786	23 939	23 562	101 813	2 672	26.73	714.47				
750	762	6.3	117.41	149.57	441 080	23 939	23 543	106 777	2 803	26.72	713.90				
750	762	8	148.76	189.50	437 087	23 939	23 436	134 683	3 535	26.66	710.73				
750	762	10	185.45	236.25	432 412	23 939	23 311	167 028	4 384	26.59	707.01				
750	762	12	221.95	282.74	427 762	23 939	23 185	198 855	5 219	26.52	703.31				
750	762	12.5	231.05	294.33	426 604	23 939	23 154	206 731	5 426	26.50	702.38				
750	762	16	294.36	374.98	418 539	23 939	22 934	260 973	6 850	26.38	695.97				
750	762	20	365.98	466.21	409 415	23 939	22 682	321 083	8 427	26.24	688.71				
750	762	25	454.39	578.84	398 153	23 939	22 368	393 461	10 327	26.07	679.74				
750	762	30	541.57	689.89	387 047	23 939	22 054	462 853	12 148	25.90	670.91				
800	813	8	158.82	202.32	498 892	25 541	25 038	163 901	4 032	28.46	810.11				
800	813	10	198.03	252.27	493 897	25 541	24 913	203 364	5 003	28.39	806.14				
800	813	12	237.05	301.97	488 927	25 541	24 787	242 235	5 959	28.32	802.18				
800	813	12.5	246.77	314.36	487 688	25 541	24 756	251 860	6 196	28.31	801.20				
800	813	16	314.48	400.62	479 062	25 541	24 536	318 222	7 828	28.18	794.33				
800	813	20	391.13	498.26	469 298	25 541	24 285	391 909	9 641	28.05	786.56				
800	813	25	485.83	618.89	457 234	25 541	23 970	480 856	11 829	27.87	776.96				
800	813	30	579.30	737.96	445 328	25 541	23 656	566 374	13 933	27.70	767.49				
900	914	8	178.75	227.70	633 348	28 714	28 212	233 651	5 113	32.03	1 026.13				
900	914	10	222.94	284.00	627 718	28 714	28 086	290 147	6 349	31.96	1 021.65				
900	914	12	266.94	340.05	622 114	28 714	27 960	345 890	7 569	31.89	1 017.19				
900	914	12.5	277.90	354.02	620 717	28 714	27 929	359 708	7 871	31.88	1 016.07				
900	914	16	354.34	451.38	610 980	28 714	27 709	455 142	9 959	31.75	1 008.33				
900	914	20	440.95	561.72	599 947	28 714	27 458	561 461	12 286	31.62	999.55				

Table 1 (Concluded)

NB mm (1)	OD mm (2)	Thickness mm (3)	Mass kg/m <sup>3</sup> (4)	Area of Cross Section cm <sup>2</sup> (5)	Internal Volume cm <sup>3</sup> /m (6)	Surface		Moment of Inertia cm <sup>4</sup> /m (9)	Modulus of Section cm <sup>3</sup> (10)	Radius of Gyration cm (11)	Square of Radius of Gyration cm <sup>2</sup> (12)
						External cm <sup>3</sup> /m (7)	Internal cm <sup>3</sup> /m (8)				
900	914	25	548.10	698.22	586 297	28714	27143	690 317	15 105	31.44	988.68
900	914	30	654.02	833.15	572 803	28714	26829	814 775	17 829	31.27	977.95
1000	1016	8	198.87	253.34	785 398	31919	31416	321 780	6 334	35.64	1 270.16
1000	1016	10	248.09	316.04	779 128	31919	31290	399 850	7 871	35.57	1 265.17
1000	1016	12	297.12	378.50	772 882	31919	31165	476 985	9 389	35.50	1 260.20
1000	1016	12.5	309.35	394.07	771 325	31919	31133	496 123	9 766	35.48	1 258.96
1000	1016	16	394.58	502.65	760 466	31919	30913	628 479	12 372	35.36	1 250.32
1000	1016	20	491.26	625.81	748 151	31919	30662	776 324	15 282	35.22	1 240.52
1000	1016	25	610.99	778.33	732 899	31919	30348	956 086	18 821	35.05	1 228.38
1000	1016	30	729.49	929.28	717 804	31919	30034	1 130 352	22 251	34.88	1 216.37
1050	1067	10	260.67	332.07	860 961	33521	32892	463 792.50	8 693.39	37.37	1 396.69
1050	1067	12	312.21	397.73	854 395	33521	32767	553 419.80	10 373.38	37.30	1 391.46
1050	1067	12.5	325.07	414.10	852 757	33521	32735	575 666.12	10 790.37	37.28	1 390.16
1050	1067	16	414.71	528.29	841 338	33521	32515	729 606.44	13 675.85	37.16	1 381.07
1050	1067	20	516.41	657.85	828 382	33521	32264	901 754.61	16 902.62	37.02	1 370.76
1050	1067	25	642.43	818.38	812 329	33521	31950	1 111 355.42	20 831.40	36.85	1 357.99
1050	1067	30	767.22	977.35	796 432	33 521	31 636	1 314 863.68	24 645.99	36.68	1 345.34
1150	1168	10	285.58	363.80	1 035 079	36 694	36 065	609 842.87	10 442.51	40.94	1 676.33
1150	1168	12	342.10	435.80	1 027 879	36 694	35 940	728 050.37	12 466.62	40.87	1 670.60
1150	1168	12.5	356.20	453.76	1 026 083	36 694	35 908	757 409.19	12 969.34	40.86	1 669.17
1150	1168	16	454.56	579.06	1 013 553	36 694	35 688	960 773.63	16 451.60	40.73	1 659.20
1150	1168	20	566.23	721.31	999 328	36 694	35 437	1 188 631.78	20 353.28	40.59	1 647.88
1150	1168	25	704.70	897.71	981 688	36 694	35 123	1 466 716.92	25 115.02	40.42	1 633.84
1200	1219	10	298.16	379.82	1 129 089	38 296	37 668	694 014.43	11 386.62	42.75	1 827.23
1200	1219	12	357.20	455.03	1 121 568	38 296	37 542	828 716.27	13 596.66	42.68	1 821.24
1 200	1219	12.5	371.93	473.79	1 119 692	38 296	37 511	862 181.09	14 145.71	42.66	1 819.75
1 200	1219	16	474.68	604.69	1 106 602	38 296	37 291	1 094 091.31	17 950.64	42.54	1 809.33
1 200	1219	20	591.38	753.35	1 091 736	38 296	37 039	1 354 154.61	22 217.47	42.40	1 797.50
1 200	1219	25	736.15	937.77	1 073 294	38 296	36 725	1 671 872.78	27 430.23	42.22	1 782.83